

# **Investigating expected technical skills of recent information technology graduates upon entering the Agile workplace**

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# CHAPTER 1: INTRODUCTION

## 1.1 Introduction

The goal of this study is to investigate the technical skills that information technology (IT) graduates are expected to have upon entering the workplace. This study explores the perspectives of recent graduates in this regard. The connection between skills obtained by graduates through tertiary education, and the skills required upon entering the workplace will be explored. The outcome of this study will thus identify potential gaps in the graduates obtained technical skills by graduates compared to the skill requirements of their first job, as per their perspectives, i.e., it presents their perspective in terms of the skills that they did not have, but would have wanted, to make the transition into the workplace easier.

The key concepts are the expected skills upon entering the workplace, and the skills graduates obtained after completing a Bachelor of Science in Information Technology degree. The skill expectations will be modelled by referencing the Agile software development approach, as used by most software development companies. This approach suggests skills expectations for its iterative phases (Conboy *et al.*, 2011). The skills obtained by graduates, focusses on technical skills they obtained throughout the course of their studies.

This proposal provides a brief overview of the key concepts, research objectives, literature reviews, and research method chosen for the study.

## 1.2 Concepts central to study

The concepts central to this study are:

### 1.2.1 Skill expectations

This key concept involves the technical skill expectations of developers within the Agile software development approach; specifically, the *construction-iteration* phase. This approach is incremental and iterative, as various phases are revisited throughout the development of projects (Szalvay, 2004), making it difficult to clearly define the phases of such an approach. Therefore, this study focusses on software development and other related skills within this approach.



### **1.2.2 Skills obtained**

The second key concept comprises the technical skills IT graduates acquired during the course of their studies. The aim the research is to understand the relevancy of these skills compared to expectations of industry. As an example, Scott *et al.* (2002) found that information system graduates lacked certain skills in CASE/modelling tools, and web-application based development.

## **1.3 Research problem and objectives**

The research problem and objectives are discussed below:

### **1.3.1 Research problem**

The need for professionals with technical IT skills have become crucial in all organisations around the world; De Villiers *et al.* (2012) say that there is a dire shortage of these skills in South Africa. However, these shortages refer to the quantity of professionals with IT skills, as confirmed by literature (Kirlidog *et al.*, 2018; Patacsil & Tablatin, 2017). It does not address the level of technical capability that the IT graduates have upon entering the workplace, so they are not necessarily sufficiently qualified to perform well enough. This study aims to address this, by exploring the graduates' perspective towards their readiness for industry, i.e., exploring the skills expectations of their first IT job after graduating. So, this study intends to answer whether these postgraduates were prepared for their first job after graduating, and what skills they were lacking, if any.

### **1.3.2 Objectives**

The objectives of this study are divided into primary and secondary objectives. They are discussed next.

#### **1.3.2.1 Primary objective**

The primary objective is to investigate the perspectives of IT graduates toward their readiness for industry. This is limited to graduates working within the incremental and iterative phases of the Agile software development approach. I.e., the technical skills expectations of IT graduates working within an Agile environment.

#### **1.3.2.2 Secondary objectives**

In order to meet the primary objective, the following secondary objectives should be fulfilled.

#### 1.3.2.2.1 Theoretical objectives

To demonstrate understanding of the key concepts, a literature review is required for:

- The Agile software development approach.
- The skill expectations of industry from recent graduates upon entering the workplace.
- The research paradigm and method of this study.

#### 1.3.2.2.2 Empirical objectives

The empirical objectives include the following:

- To explore the perspectives of recent IT graduates toward their readiness for industry, i.e., exploring the graduates expected technical skills of working within an Agile environment.
- To analyse and present the collected data from recent graduates with the use of semi-structured interviews and interpretive content analysis.

### 1.4 Research paradigm and method

This study is positioned in the interpretive research paradigm, as it explores the perspectives of graduates towards their readiness to enter the workplace. The aim of interpretative research is to understand the experiences of individuals, and attempt to give meaning to it (Chilisa & Kawulich, 2012). Qualitative data is gathered through interviews, and by using content analysis for data analysis, the perspectives and experiences of graduates are explored. The interpretive research paradigm is most suitable for this study, because exploring the perspectives of IT graduates fit into the goal of the interpretative research approach (De Villiers, 2005).

### 1.5 Data collection and analysis

The following sections describe the participants of this study, and the data analysis method used.

#### 1.5.1 Participants

The participants of this study are former students. The following criteria is used to determine whether an individual qualifies to participate in this study:

- Graduates of a Bachelor of Science in Information Technology degree.
- Currently employed within an Agile software development environment.

- Graduated within the last 2 years.

### **1.5.2 Data analysis**

The method of data analysis is done in the interpretive research paradigm. Semi-structured interviews serve as the data gathering method to produce rich qualitative data (Horton *et al.*, 2004). The research questions during such interviews are progressive, i.e., it may evolve throughout this study's progress. The aim is to reach data saturation through applying qualitative content analysis as method for data analysis (Griffie, 2005). The four (4) steps of content analysis are (Bengtsson, 2016; Erlingsson & Brysiewicz, 2017; Vaismoradi *et al.*, 2016):

1. Decontextualization: Identify meaning units from transcribed text.
2. Recontextualization: Include meaningful content, which aids in reaching research objectives, and exclude irrelevant text. Assign codes to each meaning unit.
3. Categorization: Identify categories and group homogeneous groups together.
4. Compilation: Group codes and categories together so that realistic conclusions may be drawn from the data.

### **1.5.3 Rigor**

To ensure a rigorous study the following principles defined by Klein and Myers (1999) will be applied:

- The fundamental principle of the hermeneutics circle.
- The principle of contextualisation.
- The principle of interaction between the researcher and the subjects.
- The principle of abstraction and generalisation.
- The principle of dialogical reasoning.
- The principle of multiple interpretations.
- The principle of suspicion.

## **1.6 Ethical considerations**

The interview process of this study is voluntary, and informed consent of interviewees will be obtained. The anonymity of participants will be ensured, and any knowledge acquired that is

subject to privacy will be kept confidential. The North-West University ethical process is followed.

## **1.7 Chapter layout**

This section provides the outline of this study.

### **Chapter 1: Introduction**

The aim of this chapter is to provide an overview of the study. It outlines the key concepts, research objectives, and research paradigm and method.

### **Chapter 2: Research paradigm and method**

This chapter discusses the research paradigm and method to be used and motivates the paradigm chosen. The interpretive research approach used in this study will be discussed.

### **Chapter 3: Literature review**

This chapter provides an overview of the key concept of this study, as to the expected skills of IT graduates upon entering the workplace.

### **Chapter 4: Data collection and analysis**

This chapter discusses the data collection and analysis approach used in this study. The steps of interpretive data analysis and the set of principles for conducting a rigorous study will be discussed.

### **Chapter 5: Findings and conclusion**

This chapter discusses the result of the empirical study, as to the perspective of IT graduates toward their readiness for industry. It also serves as the conclusion to the study.

## **1.8 Summary**

It is generally believed that IT graduates possess most of the skills necessary when entering the workplace (Scott *et al.*, 2002). However, in our ever-evolving IT landscape, graduates may not have all the expected skills required of them. The aim of this study is to explore the perceptions of IT graduates in this regard, i.e., to identify the perceived gaps in technical skills acquired through tertiary institutions. Furthermore, this proposal provides a general overview of this study, the motivation behind it, and explains the process to be followed to reach objectives.

## **CHAPTER 2: RESEARCH METHODOLOGY**

### **2.1 Introduction**

The primary objective of this study is to understand the perspective of IT graduates toward their readiness to enter the workplace, specifically an Agile environment. This chapter explains briefly the different research paradigms applicable in IT related research. It then discusses the research paradigm chosen for this study and motivates the choice. This chapter explains the methodology used for this study, that is positioned in the chosen research paradigm.

The goal of this study is to investigate the technical skills that information technology (IT) graduates are expected to have upon entering the workplace. This study explores the perspectives of recent graduates in this regard. To achieve this, research should be conducted on the appropriate research methodologies in order to choose the right one. This study is conducted within an interpretivist paradigm. Chilisa and Kawulich (2012) explains the aim of interpretative research as the understanding of individuals' experiences and attempting to give meaning to it. The motivation behind the chosen paradigm is discussed in this chapter.

The focus of this chapter is the research methodology and the role it has in this study, i.e., to discuss the research methodology used for determining the empirical objectives. Furthermore, the data gathering, and analysis techniques are discussed, also the ethical considerations of this study. Lastly an overall summary of the chapter is provided.

### **2.2 Research paradigms**

A paradigm is a view of the world that is based on philosophical assumptions and values which guide how problems are solved (Schwandt, 2001). The four paradigms discussed are positivism, interpretivism, design science, and critical social theory. The four philosophical assumptions (ontology, epistemology, methodology and axiology) for each paradigm are discussed.

The fundamental belief of ontology can be described as the position on the nature of reality, while epistemology is the view on what constitutes acceptable knowledge, i.e., how we know what we know (Chilisa & Kawulich, 2012; Wahyuni, 2012). The methodology refers to the model behind the research process, e.g., qualitative, quantitative, or a mix of both, and axiology is the stance of the researcher and the role of values in the research, i.e., what is believed to be true (Chilisa & Kawulich, 2012; Creswell, 2017; Wahyuni, 2012).

A comparison between the different philosophical assumptions of the paradigms are provided in Table 2.1.

**Table 2-1: Comparison of research paradigms and their philosophical assumptions.**

<b>Fundamental Beliefs</b>	<b>Research Paradigms</b>			
	Positivism	Interpretivism	Design science	Critical social theory
Ontology	A single and tangible reality which is objective and independent of bias (Chilisa & Kawulich, 2012).	Socially constructed, many intangible realities as there are many people constructing them; subjective (Chilisa & Kawulich, 2012; Wahyuni, 2012).	It may consist of multiple realities and is socio-technologically enabled (Wahyuni, 2012).	Historical realism; reality shaped by social, political, cultural, economic, ethnic, and gender values (Scotland, 2012).
Epistemology	It is only with observable phenomena that provide credible data;  Objectivity (Chilisa & Kawulich, 2012; Wahyuni, 2012).	Knowledge is subjective, socially constructed and mind dependent (Chilisa & Kawulich, 2012; Wahyuni, 2012).	Knowledge is acquired through creation (Wahyuni, 2012).	Knowledge socially constructed and influenced by society (Scotland, 2012). Subjectivity
Methodology	Quantitative, statistical, observation (Chilisa & Kawulich, 2012).	Qualitative content analysis; Grounded theory (Chilisa & Kawulich, 2012; Wahyuni, 2012).	The measurement of artefactual impacts (Wahyuni, 2012).	Critical discourse analysis, action research, and critical ethnography (Scotland, 2012)

<b>Fundamental Beliefs</b>	Positivism	Interpretivism	Design science	Critical social theory
Axiology	Value-free; The use of scientific methods of data gathering (Wahyuni, 2012).  Achieve objectivity and neutrality (Chilisa & Kawulich, 2012).	Value-bound and emic; Influenced by values, cannot be separated (Chilisa & Kawulich, 2012; Wahyuni, 2012).	Control and creation; progress through improvement and understanding (Wahyuni, 2012).	Critical analysis of realities; progress through the emancipation of people; address issues of social justice and marginalism (Scotland, 2012).

The interpretivist paradigm is chosen for this study. The suitability of interpretivism for this study is discussed next.

### **2.3 Interpretivism**

This study is positioned in the interpretive research paradigm, as it explores the perspectives of graduates towards their readiness to enter the workplace. The aim of interpretative research is to understand the experiences of individuals, and attempt to give meaning to it (Chilisa & Kawulich, 2012). Interpretative research requires the gathering of qualitative data through the use of semi-structured interviews, and by applying a method such as interpretive content analysis for data analysis, the perspectives and experiences of graduates are explored. Interpretive content analysis is the foundation for qualitative data analysis, in which concepts are formed from the data, to ultimately provide an understanding of the graduates' perspectives. This is discussed in Section 1.5.

The interpretive research paradigm is most suitable for this study, because exploring the perspectives of IT graduates fit into the goal of the interpretative research approach (De Villiers, 2005; Kaplan & Maxwell, 2005).

### **2.4 Research problem and objectives**

The research problem and objectives are discussed below:

### **2.4.1 Research problem**

The need for professionals with technical IT skills have become crucial in all organisations around the world. De Villiers *et al.* (2012) say that there is a dire shortage of these skills in South Africa. However, these shortages refer to the quantity of professionals with IT skills, as confirmed by literature (Kirlidog *et al.*, 2018; Patacsil & Tablatin, 2017). It does not address the level of technical capability that the IT graduates have upon entering the workplace, so they are not necessarily sufficiently qualified to perform well enough.

This study aims to address this, by exploring the graduates' perspective towards their readiness for industry, i.e., exploring the skills expectations of their first IT job after graduating. So, this study intends to answer how prepared these postgraduates were for their first job after graduating, and what skills they were lacking.

### **2.4.2 Objectives**

The objectives of this study are divided into primary and secondary objectives. They are discussed next.

#### **2.4.2.1 Primary objective**

The primary objective is to investigate the perspectives of IT graduates toward their readiness for industry. This is limited to graduates working within the incremental and iterative phases of the Agile software development approach and in Gauteng, South Africa.

#### **2.4.2.2 Secondary objectives**

In order to meet the primary objective, the following secondary objectives should be fulfilled.

##### **2.4.2.2.1 Theoretical objectives**

To demonstrate understanding of the key concepts, a literature review is required for:

- The Agile software development approach, providing a background of the approach, as well as popular methodologies used by software development organisations.
- The skill expectations of industry from recent graduates upon entering the Agile workplace.
- The research paradigm and methodology of this study.



#### 2.4.2.2.2 Empirical objectives

The empirical objectives include the following:

- To explore the perspectives of recent IT graduates toward their readiness for industry, i.e., exploring the graduates expected technical skills of working within an Agile environment.
- To analyse and present the collected data from recent graduates with the use of semi-structured interviews and interpretive content analysis.

### 2.5 Research method

The following sections describe the participants of this study, and the data analysis method used.

#### 2.5.1 Participants

The participants of this study are all former students. Participants were chosen using a list of criteria to determine whether an individual qualified to participate in this study. They had to meet all below listed criteria to qualify:

- Graduates of a Bachelor of Science in Information Technology degree.
- Currently employed within an Agile software development environment as a full-stack developer or software developer.
- Graduated within the last 2 (two) years.

#### 2.5.2 Data collection

According to Horton *et al.* (2004) the use of semi-structured interviews allows a researcher to weigh up the credibility of responses and thus understand underlying motives more directly. They continue by stating that these interviews allow a degree of freedom for the interviewees to explain their thoughts, which enables certain responses to be questioned in more depth to bring out and resolve apparent contradictions. The research questions are discussed next.

##### 2.5.2.1 Research questions

The research questions are formulated after the theoretical objectives have been determined and are used during the semi-structured interviews with graduates (Devers & Frankel, 2000; Griffie, 2005). The focus of these questions is to determine the perspectives of graduates toward their readiness for industry, with emphasis on the Agile software development

environment. The research questions are progressive, i.e., the questions may change throughout the interview process, ensuring that sufficient data saturation is reached (Devers & Frankel, 2000; Griffiee, 2005). The research questions are illustrated in Table 4.1, followed by the motivation of these questions.

**Table 2-2: The research questions used for data gathering.**

<b>Section A: Exploring the participants experiences regarding the education they received from completing a Bachelor of Science in Information Technology degree.</b>	
Question A1	How would you describe your experience at the university?
Question A2	What is your general perspective of the time you spent at the university?
<b>Section B: Exploring the participants experiences with the expectations of working within an Agile environment.</b>	
Question B1	What is your current job title/description?
Question B2	How would you describe the main responsibilities of your current position?
Question B3	Tell me about the technical skills you require to complete the tasks you receive from your employer?
Question B4	Do you feel like you possessed the necessary technical skills to perform well?
<b>Section C: Exploring the participants experiences with the transition from university to the workplace.</b>	
Question C1	How would you describe your experience with the transition from university to the workplace?
Question C2	What technical skills, abilities, or knowledge did you lack at the beginning of your career (if any), that would have made your transition easier, or allowed you to perform better?
Question C3	What other technical skills do you feel you were deficient in?
Question C4	Which technical skills that you have obtained did you find to be most useful?
Question C5	Which technical skills that you have obtained did you not find as useful?

The first section of questions deals with the graduates' experience regarding the education they received from completing a Bachelor of Science in Information Technology degree. The reasoning behind these questions is to understand how they perceived their university experience, and how it may influence their responses for the rest of the interview. E.g., if the graduates view their experience in a negative light, they may be more prone to answer subsequent questions with bias, like providing inaccurate responses regarding the technical skills they lacked.

The second section of questions deals with the graduates' experience with the expectations of working within an Agile environment. Firstly, it is important to understand their job title

and main responsibilities, as different job positions may require different skill sets. In this study, only full stack developers working within the Agile environment will be considered. Question B3 and B4 are formulated in relation to the objective of this study, which is to understand the technical skills expectations of graduates, and their perceived readiness to work within an Agile environment. Furthermore, the next section of questions (C1 – C5) builds on this by exploring the graduates experience with their transition from university to the workplace, what skills they required to complete tasks, and the skills they lacked which could have made their transition easier.

Once data have been collected through the use of semi-structured interviews, data analysis is done. Interpretive content analysis will serve as data analysis method in this study and is discussed next.

### **2.5.3 Data analysis**

The method of data analysis is done in the interpretive research paradigm by using content analysis, i.e., qualitative methodology. The objective of content analysis is to scientifically transform a large amount of text, as gathered through the transcriptions of interviews with participants, into a very organised and concise summary of key results (Bengtsson, 2016; Erlingsson & Brysiewicz, 2017). During this process categories are formed to enable the understanding of underlying meanings and perspectives of the participants (Chilisa & Kawulich, 2012). The steps of interpretive content analysis applied in this study are discussed next.

#### **2.5.3.1 Step 1: Decontextualization**

The researcher familiarizes themselves with the data to get a sense of the complete picture, before it is broken down into reduced meaning units (Bengtsson, 2016). A meaning unit is the smallest unit that contains some of the insights the researcher needs, and it is the collection of sentences and/or paragraphs comprised of aspects related to one another, with the main goal of answering the question set out in the research objectives (Bengtsson, 2016; Erlingsson & Brysiewicz, 2017). Each of the meaning units that are identified is marked with a code connecting it to the context of the data (Erlingsson & Brysiewicz, 2017). This process is known as the “open coding process” in literature (Berg, 2001). Codes aid in the identification of concepts around which the data can be constructed into blocks and patterns (Erlingsson & Brysiewicz, 2017). A code list is constructed which includes the definitions of the codes to ensure that the value of the codes do not change throughout the analysis process (Bengtsson, 2016). These codes are created inductively, meaning that they may

change as the study progresses and more data become available (Vaismoradi *et al.*, 2016). The coding process is done repeatedly to prevent the obscuring of meaning units throughout the analysis process (Bengtsson, 2016).

#### **2.5.3.2 Step 2: Recontextualization**

The identified meaning units are used to check whether all aspects of the content have been covered relative to the objective (Erlingsson & Brysiewicz, 2017). The researcher reads through the original text again, comparing it to the identified meaning units (Vaismoradi *et al.*, 2016). After this process, any unused text may be excluded if it has no significance to the answering of research objectives (Bengtsson, 2016).

#### **2.5.3.3 Step 3: Categorization**

This step is where categories are created. The researcher must first condense the meaning units, i.e., reducing the number of words without losing the content meaning of the unit (Erlingsson & Brysiewicz, 2017). This condensation process is needed when data is gathered through the use of interviews. This is done by dividing the coded material into broad groups based on the objectives of the study (Vaismoradi *et al.*, 2016). In this study, it will be divided based on the categories of questions asked during the data gathering process. Categories are identified during this step, which is a general concept for the underlying meaning of interpretative research (Graneheim & Lundman, 2004). Several categories may be formulated but the number of categories may be reduced later on during the data analysis process (Bengtsson, 2016). The end of this process is determined by the research objectives of this study and is completed when a reasonable explanation has been reached.

#### **2.5.3.4 Step 4: Compilation**

This step is where the analysis and writing up process begins (Bengtsson, 2016). During this step, the researcher's focus is on exploring the perception of the participants' experiences, and to transform them into consciousness (Chilisa & Kawulich, 2012). It is important that the data is considered from an unbiased viewpoint, i.e., the data should be analysed objectively (Bengtsson, 2016). The researcher gradually works through every identified category, and regularly refer back to the original transcribed text to confirm that the true sense of the data is understood (Elo *et al.*, 2014; Vaismoradi *et al.*, 2016). It is important for the researcher to be familiarized with the data, so that any concealed meanings may be recognized. The categories are grouped together with a quoted meaning unit chosen by the researcher, and quantification of the categories' counts are provided

(Bengtsson, 2016). Finally, the researcher must consider whether the results are reasonable and logic or not (Elo *et al.*, 2014).

## 2.6 Ethical considerations

Ethics may be defined as the disciplines for standards of conduct in which complex problems and issues are analysed (Resnik, 2011), i.e., the manner through which research is conducted should be based on ethical or moral standards and not cause any harm to individuals (Wiles, 2012). See Appendix A for the ethical clearance application, and Appendix B for the acceptance of the ethical clearance application.

The following ethical considerations will be used in this study:

- The participants will be requested to sign a consent form before the start of each interview, and a copy will be provided to them.
- The participation in this study will be voluntary.
- The identity of participant and any identifiable information will remain confidential. Pseudonyms will be assigned to each participant ensuring their anonymity.
- The interviews will be audio-recorded, and participants will be provided with the opportunity to review these recordings, and request that any part or all parts be destroyed.
- Participants may withdraw from the study at any point.
- Interview recordings and transcripts will be stored on password protected devices.

## 2.7 Rigor

To ensure a rigorous study the following principles defined by Klein and Myers (1999) are applied. The application of these principles in this study are illustrated in Table 2.2:

**Table 2-3: The application of the rigorous principle for interpretive research in this study (Klein & Myers, 1999).**

Principles	The application of these principles in this study
The fundamental principle of the hermeneutics circle.	<p>This refers to the relationship between “the interdependent meaning of parts and the whole that they form”.</p> <p>The graduates perceived readiness toward industry should be understood holistically, i.e., their perception should be understood by the independent parts as well as the whole that they form.</p>

Principles	The application of these principles in this study
The principle of contextualisation.	<p>This refers to the “reflection of the social and historical background of the research setting” to understand the participants’ situation.</p> <p>The graduates working environment from a social and cultural aspect should be understood. This may have an influence on how the participants perceived their transition into the workplace. The researcher should not be biased as per their own experience.</p>
The principle of interaction between the researcher and the subjects.	<p>This refers to how the “data collected were socially constructed through the interaction between the researcher and the participants”.</p> <p>As previously discussed, semi-structured interview serves as the data gathering method in this study. The researcher should allow participants to give open and honest views and should question their own assumption to improve the understanding of participants’ meanings.</p>
The principle of abstraction and generalisation.	<p>This refers to how “the interpretation of data should reflect the nature of human understanding when forming general concepts”.</p> <p>To understand the perceptions of graduates, logical reasoning should be applied to relate the analysed data to constructed general concepts. This provides the nature of the graduates’ understanding and social action in the context of this study.</p>
The principle of dialogical reasoning.	<p>This refers to the “possible sensitivity required to possible contradictions researcher’s theoretical preconceptions and the actual findings as revealed by the data”.</p> <p>The theoretical preconceptions guiding this study is the potential lack of technical skills of graduates upon entering the workplace, and this should not overshadow/influence the actual findings resulting from the analysed data (by using interpretive content analysis as a method).</p>
The principle of multiple interpretations.	<p>This refers to “possibility of multiple interpretations among the different participants and should be considered”.</p> <p>The view of participants toward their readiness for industry may be different, not only from each other, but also from the researcher. It is important that the underlying perceptions of each graduate is understood so that clear and accurate concepts may be constructed.</p>
The principle of suspicion.	<p>This refers to the “possibility of biases from participants which may cause distortions in the narratives and should be considered”.</p> <p>The possibility of biases of the graduates should be considered to ensure accurate and consistent interpretations throughout the data analysis process. Some graduates may feel bias toward their employer, or even their alma mater, which may cause distortions in the collected narratives.</p>

## **2.8 Summary**

This focus of this chapter was to briefly explain the different research paradigms applicable in IT related research. It also discussed the chosen research paradigm for this study and the motivation behind it. Interpretivism was identified as the most suitable paradigm as the goal of this study is to understand the perspectives of graduates toward their readiness for industry. Qualitative content analysis was discussed as the methodology for data analysis, and the principles to conduct a rigorous study was explained. So, this chapter reflects the research process used to guide this study.

The next chapter discusses the literature review of the Agile software development approach.

## CHAPTER 3: LITERATURE REVIEW

### 3.1 Introduction

The primary objective of this study is to understand the perspective of IT graduates toward their readiness to enter the workplace, specifically an Agile environment. The purpose of this chapter is to review current literature on the Agile approach which will be used to understand the skills expectations of IT graduates, but also the skills expectations that research has shown are required of individuals working within such an environment.

This literature review addresses the key concept of this study, namely the skills expectations from graduates upon entering the Agile environment. The purpose is to understand how relevant the actual skills obtained by graduates are to the expected skills of the environment. As an example, Scott *et al.* (2002) did a similar study for the University of Cape town, where they explored the correlation between the skills taught to students, and the skills expected from organisations, and found that students lacked certain skills in web-application based development and modelling tools upon entering the workplace. Another study done by De Villiers *et al.* (2012) found that a shortage of technical skills exist in South Africa. However, these shortages refer to the quantity of professionals with IT skills, as confirmed by literature (Kirlidog *et al.*, 2018; Patacsil & Tablatin, 2017). It does not address the level of technical capability that the IT graduates have upon entering the workplace. Therefore, this chapter aims to address this, by exploring the skills expectations from an Agile environment.

The Agile approach to software development has been adopted in many organisations working within the information technology and communication sector, and has become the leading approach to software development (Misra & Khurana, 2017). Because many organisations have adopted the Agile approach, it is researched to explore what technical skills are expected from graduates upon entering such an environment, and to understand if they are sufficiently qualified to perform well enough.

The Agile software approach and relevant methodologies are discussed in Section 3.2 and 3.2.2 respectively, to offer better understanding of the working environment graduates are in, and the technical skills required of them which is discussed in Section 3.2.3.



### 3.2 Agile software approach

The Agile software approach has gained widespread popularity (Misra & Khurana, 2017). It institutes a set of principles firstly promoted by a group of seventeen software engineers in 2001. The principles they promoted are built on the best practices of their own successful and failed experiences with various software developments of what worked and what did not (Fowler, 2002).

They advocated strongly toward the close cooperation between software development and business groups, direct communication, the regular delivery of working software portions, and a tolerance towards the changing requirements of customers (Beck *et al.*, 2001; Misra *et al.*, 2006). This was in strong contrast to other popular approaches of the time which believed in the silo development by project teams, the over-emphasis on written documentation, the final delivery of the completed product at the end, and the defining of a fixed set of requirements (Beck *et al.*, 2001; Misra *et al.*, 2006).

This means, that instead of controlling the project as a single unit, which limits changes throughout the project because phases aren't revisited, Agile introduces the idea of dividing the project work into small units to facilitate change because of the iterative and incremental nature of Agile. Team members rather work together, directly communicating to complete the smaller units, opposed to working in seclusion on tasks. This also leads to a shift of having the whole finished project as the main objective, to a focus on delivering the smaller units after the end of each cycle. These ideas are grounded in the *Manifesto for Agile Software developments*, which is discussed next.

#### 3.2.1 The *Manifesto for Agile Software Development*

The *Manifesto for Agile Software Development* was prepared in February 2001 which stated a list of values. These values are distinguished between corresponding important and less important values, and it is vital to note that the less important values are also useful in software development but should not be prioritised over more important values (Palmquist *et al.*, 2013). These values are illustrated in Table 3.1.

**Table 3-1: The values of Agile software development (Palmquist *et al.*, 2013)**

Important values	Less important values
Individuals and interactions	Processes and tools
Working software	Comprehensive documentation
Customer collaboration	Contract negotiation
Responding to change	Following a plan

It is vital to emphasise the important values, but also adopt the less important values for the proper implementation of the Agile approach. I.e., the use of processes and tools are important, but having competent people working together effectively and efficiently are more important (Abrahamsson *et al.*, 2017). This applies to all other corresponding values. The over-emphasis of either side may lead to unsuccessful development of software projects (Palmquist *et al.*, 2013). Although the Agile approach is different to other approaches such as Waterfall, and rely on its own values and principles, it still finds worth in the values of other approaches.

The basis of the Agile software approach is built on its twelve principles as defined by the *Manifesto for Agile Software Developments* (Beck *et al.*, 2001). These principles are listed below:

1. "The highest priority is to satisfy customers through early and continuous delivery of valuable software."
2. "Welcome changing requirements, even in late development. Agile processes harness change for the customer's competitive advantage."
3. "Delivering working software frequently, from a couple of weeks to a couple of months, with a preference for the shorter timescale."
4. "Business people and developers work together daily throughout the project. "
5. "Building project around motivated individuals, give them the environment and support they need and trust them to get the job done."
6. "The most efficient and effective method of conveying information with and within a development team is face-to-face conversation."

7. "Working software is the primary measure of progress."
8. "Agile processes promote sustainable development. The sponsors, developers and users should be able to maintain a constant pace indefinitely."
9. "The continuous attention to technical excellence and good design enhances agility."
10. "Simplicity – the art of maximising the amount of work not done – is essential."
11. "The best architectures, requirements and designs emerge from self-organising teams."
12. "At regular intervals, the team reflects on how to become more effective, then tunes and adjusts its behaviour accordingly."

Various methodologies of the Agile software development approach have emerged, which defines different processes and phases used to complete projects. This is discussed next.

### 3.2.2 Agile software development methodologies

The adoption of an Agile approach has led to numerous methodologies for software development. These Agile methodologies are widely used by organisations to enhance speed and ensure continuous delivery of software project (Rehkopf, 2018). Some of the popular Agile methodologies used by organisations include scrum, scaled agile framework and Kanban (Cocco *et al.*, 2011).

These methodologies are briefly illustrated in Table 3.2 by referring to five main differences namely cadence, release methodology, roles, key metrics, and change philosophy.

**Table 3-2: Comparison among Scrum, Scaled Agile Framework and Kanban Agile Methodologies**

	Scrum (Rehkopf, 2018)	Scaled agile framework (SAFe, 2019)	Kanban (Rehkopf, 2018)
Cadence	<p>The sprints usually consist of two to four weeks with clear start and finish dates (Matharu <i>et al.</i>, 2015).</p> <p>Sprints consist of planning, review and retrospective meetings.</p> <p>Scrum ceremonies are lightweight and run on a continuous basis.</p>	<p>The short iterations form part of the larger Program Increments (PI).</p> <p>This smaller and shorter iterations ensure that important events (planning, demos, inspections and adaptations) occur regularly and on schedule.</p>	<p>This is based on a continuous workflow structure.</p> <p>This allows for the ability to better adapt to changing priorities.</p> <p>Cards on a Kanban board represent work items. Arranged in columns on the board by the flow from one stage of workflow to another.</p>

	Scrum (Rehkopf, 2018)	Scaled agile framework (SAFe, 2019)	Kanban (Rehkopf, 2018)
Release method	Goals and objectives are set for each sprint which may be approved for release on not during sprint review meetings.	Includes several strategies depending on context and situation. Methods include releasing on PI cadence, releasing less/more frequently, and releasing on demand.	There is no regular schedule or predetermined due dates. Rather, updates are released as they are ready.
Roles	Three clearly defined roles (Matharu <i>et al.</i> , 2015): <ul style="list-style-type: none"> <li>• Product owner</li> <li>• Scrum master</li> <li>• Development team</li> </ul>	The team roles include: <ul style="list-style-type: none"> <li>• Product owner</li> <li>• Scrum master</li> <li>• Development team</li> <li>• Agile team</li> </ul>	The Kanban board is own by the entire team, so there are no prescribed roles (Matharu <i>et al.</i> , 2015).  Agile coaches may be enlisted, but ultimately it is the shared responsibility of the whole team to deliver the tasks on the board.
Key metrics	The amount of completed story points – referred to as velocity – is the central metric.	The metrics used are dependent on the size and type of project and may include metrics like cumulative flow diagrams, program performance metrics, and feature progress reports.	A cumulative flow diagram is used to analyse and understand the number of work items in each state.  This includes lead and cycle times which are important metrics that indicate the success of the teams.
Change philosophy	During a sprint teams strive to limit change. Changes are made after each sprint and before the next starts (Matharu <i>et al.</i> , 2015).	All changes are made during the inspect and adapt events at the end of each Program Increment.	The workflow may change at any time and include additions of new work items or removal of others (Matharu <i>et al.</i> , 2015).

Although each methodology discussed has variations to its processes and how it defines the phases of software development, the general goal of each is to adapt to change and ultimately deliver operational software as rapidly as possible (Misra *et al.*, 2006). This study focusses on the general objective as illustrated by the different methodologies of the Agile approach. This general idea will be used to understand the technical skill expectations of graduates upon entering the workplace.

The general processes of the Agile approach are discussed next.

### 3.2.3 Agile process flow

The Agile software development approach consists of several iterative processes as illustrated in Figure 3.1 (Abrahamsson *et al.*, 2017):



**Figure 3-1: Agile process flow diagram**

1. “Concept: Projects are envisioned and prioritised.”
2. “Inception: The team members are identified; initial requirements and funding are discussed.”
3. “Iteration/Construction: The development team work to complete tasks and deliver the operational software.”
4. “Release: Quality assurance is done through testing; training is provided; the final release of the iteration goes into production.”
5. “Production: The ongoing support of the software through maintenance.”
6. “Retirement: Includes the end of life activities.”

The Agile methodologies discussed in Section 3.2.1 form part of the iteration/construction process and will be used to understand the skills expectations of graduates upon entering the workplace. The graduates thus forms part of the development team functioning to deliver working software and require certain technical skills to successfully accomplish their responsibilities. These technical skills expectations are discussed next.

### 3.2.4 Skill expectations

The Agile development team may be described as self-organising and cross-functioning which does not comprise of the tradition software approach task roles (Thummadi *et al.*, 2011). These traditional approaches included roles such as designers, programmers, architects, and testers (Balaji & Murugaiyan, 2012). Rather, every team member collaborates to complete the work that has been assigned within each sprint or iteration. So, instead of having the different role groups working in isolation on their component of the project, all team members offer input to the project work which may increase efficiency and

consistency of the project deliverables. Because of this collaborations, the team members may be required to have general knowledge of a number of the below listed technical skills in order to collaborate with other members and complete the assigned work to be valuable contributors to the group (Omar *et al.*, 2018). I.e., it can be said that a team member should be a jack of all trades and a master of none, or sometimes a master of some, like having expert knowledge of certain domains.

As previously mentioned, the Agile roles include a scrum master, product owner and the development team (generalised from the discussed Agile methodologies). According to Omar *et al.* (2018) the following technical skills are required when working in development teams within an Agile environment, as supported by literature:

- Programming languages such as C, C++, C#, Java and Python. A high proficiency in these languages are essential to allow for faster construction of complex projects (McCuller, 2012; Zaraket *et al.*, 2014). This skill is one of the fundamental building blocks of any software project, and not only having the ability to write code, but also to solve complex problems using computer code are essential.
- Spoken and written communication skills. Individuals should be able to clearly communicate technical related aspects of project with fellow team members (McCuller, 2012). The use of proper terminology and technical phrases are important to accurately communicate with team members to avoid miscommunication.
- Database skills such as MySQL, Microsoft SQL Server, Oracle, Sybase and IBM DB2. The storing and retrieving of data are an important aspect of any software project and having the necessary database skills are key to ensure consistency, accuracy, and security of data.
- Expert areas or domains. This refers to having knowledge in a specific area such as artificial intelligence (AI), business software/knowledge, and platforms like SharePoint or Microsoft Teams.

The listed skills expectation will be used to uncover correlations between the graduates' perceived readiness for industry compared to the skills obtained through university. This will be done in the next chapter which is data analysis.

### **3.3 Summary**

The purpose of this chapter was to review current literature on the Agile approach which will be used to understand the skills expectations of IT graduates, but also the skills expectations that research has shown are required of individuals working within such an environment.

An overview was provided of the Agile software development approach which discussed the iterative and incremental nature of such an approach. Although many Agile methodologies exist, it is clear that the general goal of this approach is to adapt to change and ultimately deliver working software as quickly as possible.

It was discussed how this general goal of Agile is in strong contrast to previously popular approaches, which has led to the change of skills expectations from individuals working in such environments. These skills expectations were discussed and is used to explore the correlation to the skills graduates obtained through university. This will be discussed in the next chapter which is data analysis.

## **CHAPTER 4: DATA GATHERING AND ANALYSIS**

### **4.1 Introduction**

The primary objective of this study was to understand the perspective of IT graduates toward their readiness to enter the workplace, specifically an Agile environment, i.e., to understand the correlation between the technical skills acquired from their tertiary education compared to the technical skills expectations upon entering the workplace. This study explored the perspectives of recent graduates in this regard. The purpose of this chapter is to discuss the process of data collection and analysis through the use of semi-structured interviews and interpretive/qualitative content analysis respectively, and also define the participants and questions used in this study.

The participants are discussed in Section 4.2, followed by data collection in Section 4.3, data analysis and result interpretation in Section 4.4. Finally, Section 4.5 serve as the conclusion to this chapter.

### **4.2 Participants**

The participants of this study are all former students from a university in South Africa. Participants were chosen using a list of criteria to determine whether an individual qualified to participate in this study. They had to meet all below listed criteria to qualify:

- Graduates of a Bachelor of Science in Information Technology degree.
- Currently employed within an Agile software development environment as a full-stack developer or software developer.
- Graduated within the last two (2) years.

### **4.3 Data gathering**

This study is positioned in the interpretive research paradigm, as it explores the perspectives of graduates toward their readiness to enter the workplace. As previously discussed, the aim of interpretive research is to understand the experiences of individuals, and attempt to give meaning to it (Chilisa & Kawulich, 2012). The data gathering method used in this study is semi-structured interviews. This means that the interview questions are open-ended to allow for new ideas to be brought up during the interview process. A general framework of ideas, consisting of three sections, are used to explore the perspectives of participants. The questions are rooted in the objectives of this study, which were discussed in Chapter 2. The research questions are presented in Table 4.1.



**Table 4-1: The research questions used for data gathering.**

<b>Section A: Exploring the participants experiences regarding the education they received from completing a Bachelor of Science in Information Technology degree.</b>	
Question A1	How would you describe your experience at the university?
Question A2	What is your general perspective of the time you spent at the university?
<b>Section B: Exploring the participants experiences with the expectations of working within an Agile environment.</b>	
Question B1	What is your current job title/description?
Question B2	How would you describe the main responsibilities of your current position?
Question B3	Tell me about the technical skills you require to complete the tasks you receive from your employer?
Question B4	Do you feel like you possessed the necessary technical skills to perform well?
<b>Section C: Exploring the participants experiences with the transition from university to the workplace.</b>	
Question C1	How would you describe your experience with the transition from university to the workplace?
Question C2	What technical skills, abilities, or knowledge did you lack at the beginning of your career (if any), that would have made your transition easier, or allowed you to perform better?
Question C3	What other technical skills do you feel you were deficient in?
Question C4	Which technical skills that you have obtained did you find to be most useful?
Question C5	Which technical skills that you have obtained did you not find as useful?

It is important to note that the interview questions are progressive, i.e., they may have evolved throughout the interview process. The aim of these interviews was to reach data saturation, i.e., no new information emerged from subsequent interviews. A total of four participants were interviewed. Although data saturation was reached after the third interview, two more interviews were conducted for safe measure. According to Marshall *et al.* (2013), for smaller case studies, no more than 4 or 5 sources of information (interviews) are required to reach data saturation, as supported by literature (Mason, 2010; Morse, 1995).

The semi-structured interviews were conducted face-to-face. At the start of each interview the participants were requested to sign a consent form which assured them of anonymity, confidentiality and security of the data to be collected. A copy of the consent form was also provided to them (see Appendix C for an example of the consent form provided to participants). The sessions were audio-recorded, and the researcher also made written notes throughout the interviews. The participation of interviewees was voluntary, and they

did not receive any benefits as a result of their participation. After the session, interviewees were provided with the opportunity to review audio-recordings, and request that any part or all parts be destroyed.

#### 4.4 Data analysis

According Erlingsson and Brysiewicz (2017) the objective in qualitative data analysis is to systematically transform a great amount of text into structured and concise summary of key results. The qualitative data analysis steps applied are discussed below.

##### 4.4.1 Step 1: Decontextualization

This step entails the shortening of transcribed text while still preserving the core meaning (Bengtsson, 2016). The researcher identified meaning units which contain some of the insight needed for the research objectives after being familiarized with the data. The researcher had to obtain a sense of the whole, before it could be broken down into smaller units. Each of these measure units were assigned a code, which is understood in relation to the context. These codes aided in the identification of various categories in Step 3 of qualitative content analysis. Table 4.2 illustrates an example of these meaning units which are extracted from the original text, along with the assigned codes for each meaning unit. Also refer to Table 4.1 for a complete set of interview questions.

**Table 4-2: Extracted responses to question A1 and A2.**

Meaning unit	Assigned code
"I learned a lot, but the programming courses weren't extensive or challenging enough. It was too basic, and I would have liked more advanced programming skills..."	Adequate foundation of skills.  Lacked required technical skills.
"It was a positive experience because of the learning environment. The workload wasn't too much, and enough resources were available..."	Positive experience.

##### 4.4.2 Step 2: Recontextualization

In this step, the researches re-examined the content to see whether all aspects have been covered in relation to the objective of this study (Bengtsson, 2016). The original text was compared to the final list of meaning units to ensure completeness and that the true meaning of the content was ensured (Erlingsson & Brysiewicz, 2017). Any irrelevant content was

excluded as it didn't bear any significance to the objectives of this study. Table 4.3 illustrates an example of discarded text.

**Table 4-3: Discarded text: Extracted responses to question A1 and A2.**

Discarded text	Reasoning
"I wasn't that social, I was introverted. I didn't have a crazy social life..."	The social aspect of participants university experience has no significance to the research objectives.

#### 4.4.3 Step 3: Categorisation

In this step, the researcher condensed the meaning units, i.e., the number of words were reduced without losing the original meaning of the unit. This was followed by the identification of categories. These categories are rooted in the data and are dependent on the objective of this study. The researcher ensured that the identified categories are homogeneous, meaning that the data only fits into one, and only one category. This process is illustrated in Table 4.4.

**Table 4-4: Condensed meaning units and categories: Extracted responses to section B questions.**

Meaning unit	Condensed meaning unit	Code	Category
"I did not necessarily have the required technical skills to perform well enough at first, but I had a good understanding of the basics of everything..."	Did not have required technical skills to perform well. Good proficiency in basic technical skills.	Lacked required technical skills. Adequate foundation of skills.	Technical skills. Technical skills.
"The way that systems work in my workplace are totally different than what we done at the university...programming basics were very helpful, it provided me with the ability to learn new concepts faster...The programming structure at my workplace was different to what I'm familiar with..."	Programming basics helpful to increase proficiency of skill.  Implementation of programming structures differed from familiar techniques.	Adequate foundation of skills.  Lacked required technical skills.	Technical skills.  Technical skills.

These responses were condensed, categorized, and the codes were re-examined to confirm consistency and ensure the true meaning of the responses were maintained. The questions in section B were aimed at exploring the graduates' perceptions regarding their experiences of working within an Agile environment, and understanding their perceived technical skills

expectations compared to the technical skills they have acquired. See table 4.5 for another example of this process.

**Table 4-5: Condensed meaning units and categories: Extracted responses to section C questions.**

Meaning unit	Condensed meaning unit	Code	Category
"The transition was very stressful for the first few weeks...The company did a lot of different things that you do not learn at the university, everything is different. As time goes on, you adjust and catch up..."	Stressful transition at first. Expected to do unfamiliar tasks. Adjusted and adapted with time.	Stressful transition.  Lacked required technical skills.	Transition from university to the workplace. Technical skills.
"The transition was stressful, as I did not know what to expect. I was afraid I will not be able to do the work...My workplace took it slow, as they knew I was a newly graduate...I was not fully prepared. My first task was something I have never done, I recognised the code, but not the flow and implementation of it..."	Stressful transition; did not know what to expect. Implementation and flow of programming differed from familiar techniques.	Stressful transition.  Lacked required technical skills	Transition from university to the workplace. Technical skills.
"I feel like I was lacking in front-end, like Angular which was new, and we never did it at university level. Skills like JavaScript, CSS and HTML wasn't too hard to pick up, but more experience would have made it easier...The database skills I acquired was sufficient for the workplace, we learnt a few new things at work, but not anything that would have been more helpful...Dependency injections was a big thing to learn, it is a big part of sending data around to avoid security risks..."	Lacked front-end development skills (Angular). JavaScript, CSS and HTML easier to learn, more experience helpful. Adequate database knowledge. Lacked knowledge about dependency injections.	Front-end: Angular, JavaScript, CSS, HTML.  Adequate database skills.  Lacked dependency injection skills.	Lacking technical skills.  Adequate technical skills.  Lacking technical skills.

The questions in section C were aimed at exploring the graduates' perceived experience regarding their transition from university to the workplace and understand their perceptions towards the technical skills they lacked which may have made their transition easier or allowed them to perform better. As an example, the codes "Lacked required technical skills"; and the code "Adequate database skills" were assigned to some of the above meaning units. These codes mean that if a graduate was assigned the code "Lacked required technical skills", their perception was that they did not possess the necessary technical skills required to complete workplace tasks, and if the code "Adequate database skills" were assigned, it means that the technical skills they acquired from their time at the university were sufficient to complete workplace tasks. These code definitions ensured that they are applied consistently throughout the data analysis process.

#### 4.4.4 Step 4: Compilation

In this step, a summary of the categories, codes, and number of occurrences were done. The researcher ensured that the collected data were considered from a neutral perspective. The compilation was done by the use of participants words, referring back to original interview text, in order to retain the original meaning and context of the participants. This process is illustrated in Table 4.6 and findings are discussed in Section 4.5.

**Table 4-6: Summary of categories and codes**

Category	Code	#
University experience	Positive experience overall	4
	Neutral experience	1
Technical skills	Lacked required technical skills	7
	Good basis of technical skills	6
	Wanted more practical work	2
Transition from university to the workplace	Stressful transition	5
Job title	Graduate software developer	1
	Intern full stack software developer	1
	Junior full stack software developer	3
Technical skills expectations	Front-end: JavaScript	5
	Front-end: jQuery	1
	Front-end: CSS	5
	Front-end: HTML	5
	Front-end: Angular	5
	Back-end: C# (advanced programming skills)	5
	ASP.Net Core (MVC)	5
	Databases (SQL)	5
Inadequate technical skills	Front-end: JavaScript	4
	Front-end: jQuery	1
	Front-end: CSS	4
	Front-end: HTML	4
	Front-end: Angular	4
	Back-end: C# (advanced programming skills)	5

Category	Code	#
Inadequate technical skills (cont.)	ASP.Net Core (MVC)	4
	Databases (SQL)	0
Most useful technical skills acquired	Programming (C#)	5
	Databases	5
	Architectural patterns: MVC basics	1

#### 4.5 Report on findings

University experience: All participants reported an overall positive experience regarding their time spent at the university. This finding is important to understand any negative bias a participant may have toward the university.

Technical skills: Although all participants reported to have lacked some technical skills that their employer expected, they did have the basic foundation of skills enabling them to quickly adapt and acquire new skills. Some of the participants also stated that they would have preferred a more practical approach towards the application of knowledge acquired from theoretical work during the course of their studies.

Transition from university to the workplace: All participants reported a stressful experience. They contributed this to being unfamiliar to industry specific practices and techniques compared to the practices they were exposed to at the university.

Job title: All participants were employed as junior/intern/graduate program full stack software developers working within an Agile environment.

Technical skills expectations and deficiencies: As full stack software developers, the participants are expected to perform front-end and back-end software development, as well as have the necessary database skills. Participants reported that the level of programming skills expectations are of advanced level. The participants reported on the following skills they lacked:

- Front-end development (JavaScript, CSS, HTML, Angular): The participants reported that they lacked the necessary skills in script/mark-up based languages, however they did have the basic knowledge, and were familiar with most concepts except for Angular. They also noted that having a dedicated subject for front-end development would have been more useful.

- Back-end development: The participants had basic programming knowledge of the C# language which was sufficient for basic projects; however, a higher proficiency of programming skills was needed for larger and more complex projects. They were unfamiliar with the relevant methods of coding techniques and the implementation and structure of code which differs from those exposed to from university.
- ASP.Net Core (MVC): They were familiar with the basics of the MVC architectural pattern but lacked the knowledge for proper implementation, such as the use of controllers and managers. They were unfamiliar with an important concept they needed to implement namely dependency injections, and concepts like Entity Framework and Link.
- Database skills: The participants reported that their database skills were sufficient to fulfil workplace expectations.

The participants noted that the most useful skills they acquired during the course of their studies were the basics of programming (C#, object-oriented programming), Database skills (SQL, querying, reporting, analytics), and the basics of ASP.NET Core using the MVC framework for web development.

#### **4.5.1 Correlation between expectations of an Agile environment and technical skills acquired through tertiary education.**

The technical skills expectations of working within an Agile environment were explored during the literature review. Refer to Chapter 3, Section 3.2.4, for the full discussion on the skill expectations of an Agile environment.

As discussed in Chapter 3, the following technical skills are required when working in development teams within an Agile environment:

- High proficiency in programming languages such as C, C++, C#, Java and Python.
- Database skills such as MySQL, Microsoft SQL Server.
- Expert areas or domains such as artificial intelligence.

Table 4.7 illustrates the correlation between the technical skills expectations of an Agile environment, as explored during the literature review, and the technical skills acquired by graduates which they needed to fulfil workplace expectations.

**Table 4-7: Summary of skills expectations vs. skills acquired**

<b>Skills expectations (Literature review)</b>	<b>Skills acquired by graduates</b>
High proficiency in programming languages	The graduates noted that they were not highly proficient in programming to complete complex tasks. However, they did have the necessary foundation of programming skills to learn new concepts and adapt to the technical expectations of their workplace.  It was also discovered that the graduates had more difficulty with the programming structure and implementation, more than understanding the coding itself.
Database skills	All graduates who participated in this study noted that their database skills were sufficient for workplace expectations. New concepts were encountered, however they quickly adapted.
Expert areas	The graduates noted that currently their workplace tasks do not require expert area knowledge. They did state that the university did provide them with the basic knowledge of some expert domains such as artificial intelligence.

The overall takeaway from the results are that the participants possessed the basic skills for most of their workplace expectations. These basic skills enabled them to adapt by learning new, more advanced concepts, and ultimately meet employer expectations after some period of time. The participants noted that their employers had a good understanding towards them as newly graduates and were patient with them through the transition/learning time period.

#### **4.6 Summary**

This chapter explained the data gathering and analysis method used in this study. The interview questions were defined, as well as the data gathering method namely semi-structured interviews. The qualitative content analysis process, and how it was applied in this study were discussed. Meaning units were identified from the data and condensed before codes and categories were assigned. Lastly, the findings were analysed and reported on in Section 4.4. The next chapter is the conclusion to this study.



## **CHAPTER 5: CONCLUSION**

### **5.1 Introduction**

The goal of this study was to investigate the technical skills that information technology graduates are expected to have upon entering an Agile workplace. This study explored the perspectives of recent graduates in this regard. The Agile software development approach was researched to uncover the skills expectations of working within such an environment. It was used to understand the connection between the skills obtained by graduates through tertiary education, and the skills required upon entering the workplace.

The purpose of this chapter is to provide an overview of the study discussed in Section 5.2, the contributions of the study in Section 5.3, the limitations of the research and future research in Section 5.4, and finally Section 5.5 is the conclusion to this chapter.

### **5.2 Overview of the research**

This study was positioned in an interpretive research paradigm. Qualitative data was collected with the use of semi-structured interviews. Participants were interviewed face-to-face, and a total of five (5) participants were interviewed. Data was analysed using content analysis as technique. This research study consists of five (5) chapters, and a summary of each is provided next:

#### **Chapter 1: Introduction**

The aim of this chapter was to provide an overview of the study. The research problem was discussed, along with the key concepts. The research objectives were defined, consisting of primary and secondary objectives. The interpretive research paradigm was discussed, followed by the data gathering and data analysis method. Lastly the participants were defined followed by the ethical consideration which were applicable to this study.

#### **Chapter 2: Research methodology**

The applicable research paradigms in an information technology field were discussed, and the interpretive paradigm, as chosen for this study, was defined and motivated. The ethical considerations for this study was discussed. Next, semi-structured interviews were chosen and defined as the data gathering method for this study. Lastly, the data analysis method, namely content analysis, was discussed and the implementation thereof was defined.

### **Chapter 3: Literature review**

This chapter was based on the key concepts of this study. The literature review was done on the Agile software development approach, by providing an overview of the approach, the history of the approach, and what the technical skills expectations are from such a development environment.

### **Chapter 4: Data collection and analysis**

The purpose of this chapter was to meet the empirical objectives of this study. This was achieved by interviewing participants until data saturation was reached, after which the data was analysed by applying the steps of content analysis. Participants consisted of recently IT graduates from a university in South Africa.

The aim of this chapter was to explore the perspectives of recent graduates regarding the technical skills they were expected to have upon entering the workplace. The results of this study were discussed, which were based on the empirical results, and the technical skills expectations from an Agile environment (as defined during the literature review).

### **Chapter 5: Conclusion**

This chapter serves as the conclusion to the study, providing an overview, as well as the contributions and limitations of the research.

#### **5.3 Contribution of the research**

The overall results are that the participants possessed the basic skills for most of their workplace expectations. These basic skills enabled them to adapt by learning new, more advanced concepts, and ultimately meet employer expectations after some period of time.

A higher proficiency in some skills may have been helpful during the transition from university to workplace, and more experience in the form of practical application from the university may be helpful to better prepare IT graduates. The most notable technical skill lacking was front-end development skills, such as script- or mark-up based languages, and higher proficiency in programming related skills.

#### **5.4 Limitations and future research**

The following limitations were identified in this study:

- This study only used recent graduates from on university campus in South Africa.

- The number of graduates interviewed were five (5), which means the finding may be limited.
- The study did not investigate the specific technical skills expectations of various organisations, and only relied on literature to uncover technical skills expectations. These expectations were generalised and may not be specifically applicable to the expectations of the graduates' respective employers.

This study was done as part of a research project for an honour's degree, which enables the opportunity for future research in the following ways:

- Data may be gathered from not only one university campus, but also other campuses and even several other universities in South Africa. This may provide finding which are less limited.
- The study may be broadened by additional objectives, as including employer expectations. Different software development organisations may provide a better understanding of the technical skills they expect from recent graduates, understanding the importance of various technical skills, instead of relying only on literature.

## **5.5 Conclusion**

The goal of this study was to investigate the technical skills that information technology graduates are expected to have upon entering an Agile workplace. This study explored the perspectives of recent graduates in this regard. The study achieved its primary and secondary objectives.

The results of this study indicate that graduates have most of the technical skills they are required to have to meet employer expectations. Furthermore, the results show if the graduates indeed lacked some technical skill, they had a proper foundation of the basic to learn new skills and adapt to their working environment.

This chapter provided a brief overview of the study and identified limitations and future research considerations.

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## APPENDIX A: ETHICAL CLEARANCE APPLICATION

### SECTION B: Student Statement on Research Ethics

*Please answer each question by ticking the appropriate box<sup>1</sup>:*

	Yes	No
1. Does the study involve participants who are particularly vulnerable <sup>2</sup> or unable to give informed consent? (e.g. children, people with learning or other mental or physical disabilities, people who are incarcerated, unemployed or otherwise compromised in responding to your questions)	<input type="checkbox"/>	<input checked="" type="checkbox"/>
2. Will it be necessary for participants to take part in the study without their knowledge and consent at the time? (e.g. covert observation of people)	<input type="checkbox"/>	<input checked="" type="checkbox"/>
3. Will the study involve discussion of, or questions about, a sensitive topic? (e.g. sexual activity, drug use, crime, harassment, violence)	<input type="checkbox"/>	<input checked="" type="checkbox"/>
4. Are drugs, placebos or other substances (e.g. food substances, vitamins) to be administered to the study participants or will the study involve invasive, intrusive or potentially harmful procedures of any kind or any physical, psychological or socio-economic intervention?	<input type="checkbox"/>	<input checked="" type="checkbox"/>
5. Will blood or tissue samples be obtained from participants?	<input type="checkbox"/>	<input checked="" type="checkbox"/>
6. Could the study induce physical, psychological or social stress or anxiety or cause harm or negative consequences beyond the risks <sup>3</sup> encountered in normal life?	<input type="checkbox"/>	<input checked="" type="checkbox"/>
7. Will the study require the personal identification of individuals for follow-up evaluation? (i.e. through names and surnames, identification or staff numbers)	<input type="checkbox"/>	<input checked="" type="checkbox"/>
8. Will financial inducements (other than reasonable expenses and compensation for time) or inducements of any other kind be offered to participants?	<input type="checkbox"/>	<input checked="" type="checkbox"/>

<sup>1</sup> Adapted from Economic and Social Research Council (2005). Research Ethics Framework (REF). [www.esrcsocietytoday.ac.uk](http://www.esrcsocietytoday.ac.uk)

<sup>2</sup> **Vulnerable groups** raise special issues of informed consent and potential risk. "Vulnerable" participants are not clearly described, but have been noted to include "...children, prisoners, pregnant women, mentally disabled persons, economically or educationally disadvantaged persons" (Common Federal Policy, 1991). Weijer and Emanuel (2000) consider participants to be vulnerable if they are not in a position to provide informed consent, due to their position (such as being in prison), or not possessing adequate intellectual faculty (such as children or the mentally ill). "Children" here are defined as participants younger than 18 years of age.

<sup>3</sup> **Risk:** These possible risks are described as an "...invasion of privacy, loss of confidentiality, psychological trauma, indirect physical harm, embarrassment, stigma, and group stereotyping" (Oakes, 2002: 449), and also risks posed to "...a subject's personal standing, privacy, personal values and beliefs, their links to family and the wider community, and their position within occupational settings, as well as the adverse effects of revealing information that relates to illegal, sexual or deviant behaviour" (Economic and Social Research Council (ESRC), 2005: 21). Minimal risk may be defined as where "...the probability and magnitude of harm or discomfort anticipated in the proposed research are not greater, in and of themselves, than those ordinarily encountered in daily life" (Code of Federal Regulations, 2005).



9. Could the image of the NWU, the relevant academic department, your employer, or any other institution however affected by/involved in the project be negatively affected by this research or put in a bad light?

☐ ☒

**In answering the following 2 questions; consider the classification of the research also as being of *no, low, medium or high* risk, according to NWU guidelines. Attach documentation in which you outline/describe your motivation for this classification.**

10. Are you planning on making use of NWU students and/or direct and/or secondary/contracted staff members as research subjects in this research? Also please indicate anticipated *level* of risk:

☐ ☒

No risk	Low risk	Medium risk	High risk
---------	----------	-------------	-----------

11. Will the study require the co-operation of a gatekeeper for initial access to the groups or individuals to be recruited? (e.g. students at school, members of self-help groups, residents of a nursing home, the Minister of Education, a tribal chief or village elder). Also please indicate anticipated *level* of risk:

☐ ☒

No risk	Low risk	Medium risk	High risk
---------	----------	-------------	-----------

Please note that it is your responsibility to follow NWU's *Guidelines for Ethical Research* as set out in the *Manual for Postgraduate studies* and any other relevant academic or professional guidelines in the conduct of your study. **This includes providing appropriate information sheets and consent forms, and ensuring the confidentiality in the storage and use of data, and anonymity of participants.** Any significant change in the question, design or conduct over the course of the research should be notified to the Study Leader and may require a new application for ethics approval.

I have read the NWU's Manual for Postgraduate Studies and am familiar with the Guidelines for Research Ethics contained therein<sup>4</sup>.

☒ ☐

I have familiarised myself with the NWU Policy on Plagiarism and Academic Misconduct, and submit myself thereto.

☒ ☐

<sup>4</sup> <http://www.nwu.ac.za/sites/www.nwu.ac.za/files/files/i-research-support/ResearchLinkdocs/EnglishPDFs/PGManual.pdf>

**Student**

Name and Surname:

Luke Coetzee

Signature:



Date:

07/06/2019

**Supervisor**

Name and Surname:

Dr. Carin Venter

Signature:



Date:

10-06-2019

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<sup>4</sup> <http://www.nwu.ac.za/sites/www.nwu.ac.za/files/files/i-research-support/ResearchLinkdocs/EnglishPDFs/PGManual.pdf>

## APPENDIX B: ETHICAL CLEARANCE ACCEPTANCE



FACULTY OF NATURAL AND AGRICULTURAL SCIENCES,  
VAAL TRIANGLE CAMPUS

SCIENTIFIC COMMITTEE

### CLASSIFICATION OF RESEARCH

Dissertation (M)	<input type="checkbox"/>
Thesis (PhD)	<input type="checkbox"/>
Article	<input type="checkbox"/>
Hons	<input checked="" type="checkbox"/>

### REGISTERED TITLE OF DISSERTATION / THESIS / PROJECT TITLE OF ARTICLE

As per document

SUPERVISORS / PROMOTERS / STUDENT / RESEARCHERS	TITLE, INITIALS & SURNAME	STUDENT / STAFF No.	SCHOOL
Student	COETZEE, LUKE	23676469	Computer Science and Information Systems
–			–
–			–
–			–
–			–
–			–

### ETHICAL CLASSIFICATION

Classification	Low risk
Reference number	<b>FNAS-VC-SC-20190611-1</b>
Date of Scientific Committee Meeting)	11-Jun-2019

J.T. Janse van  
Rensburg

CHAIRPERSON: SCIENTIFIC COMMITTEE

Digitally signed by J.T. Janse van  
Rensburg  
Date: 2019.06.21 02:04:02 +02'00'

11-Jun-2019

DATE

## APPENDIX C: CONSENT FORM



Scientific number: FNAS-VC-SC-20190611-1

**North-West University  
Vaal Triangle Campus  
Faculty of Natural and Agricultural Sciences  
School of Computer Sciences and Information System**

### **Consent Form**

You have been invited to take part in a research study about the technical skills expectations of NWU information technology graduates upon entering the Agile workplace. This study is conducted by Luke Coetzee, as part of his Honours research project. His faculty supervisor is Dr Carin Venter.

If you agree to be in this study, you will be asked to participate in a semi-structured interview about your experiences in education through which you obtained a Bachelor of Science in Information Technology degree, your experiences of transitioning from university to the workplace, and your experiences of working within an Agile environment.

Your interviews will be audio-recorded. You may review these recordings and request that all or any portion of the recording be destroyed.

Participation in this interview will take approximately 20 minutes.

There are no known risks associated with your participation in this research beyond those of everyday life. You will receive no direct benefits.

Confidentiality of your research records will be strictly maintained by assigning pseudonyms to you and/or your firm, as well as by obscuring specific identifying details associated with you and/or your firm. Interview audio recordings and transcripts will be stored on password protected computers.

Participation in this study is voluntary. You may refuse to participate or withdraw at anytime without penalty. You have the right to skip or not answer any questions you prefer not to answer for any reason or for no reason.

If there is anything about the study or your participation that is unclear or that you do not understand, if you have questions or wish to report a research-related problem you may contact Luke Coetzee at +27 61 488 6016, Luke.Coetzee@nwu.ac.za, or the faculty supervisor, Carin Venter at +27 16 910 3276, Carin.Venter@nwu.ac.za.

You have received a copy of this consent document to keep.

### **Agreement to Participate in the interview with Luke Coetzee**

---

Subject's Name

Subject's Signature

Date